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**SHANGHAI MARITIME UNIVERSITY**



**WORLD MARITIME UNIVERSITY**

Shanghai, China

**RESEARCH ON THE RISKS INFLUENCING  
EBITDA OF C SHIPPING COMPANY**

By

**BAI BING**

**China**

A research paper submitted to the World Maritime University in partial  
fulfillment of the requirements for the award of the degree of

**MASTER OF SCIENCE**

In

**INTERNATIOANL TRANSPORT AND LOGISTICS**

**2013**

## **Declaration**

I certify that all the material in this research paper that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this research paper reflect my own personal views, and are not necessarily endorsed by the University.

Signature: 白冰

Date: 2013.6.10

## **Supervised by**

Professor Xu Dazhen

Shanghai Maritime University

## **Acknowledgement**

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Finally, I would like to show my classmates who encourage me to finish the paper successfully. To all of my classmates I would like to express my gratitude for their support and cooperation during my study in last 2 years.

## **Abstract**

Title of Research Paper: **The Research on the Risks Influencing EBITDA of  
C Shipping Company**

Degree: **MSc**

The paper is a research on the risks influencing EBITDA of C shipping company, listing and analyzing three types of risks, which may influence the EBITDA of C shipping company.

Shipping industry is a risk-taking industry, and there are several types C shipping company may be faced with. In the research paper, three main types of risks, named as the exchange rate risk, the interest rate risk and the bunker price risk, which may have the effect on the operating profit – EBITDA, are introduced and analyzed.

The research paper aims to examine to what extent that each type of risk has the effect on the EBITDA of C shipping company, so the Vector Regressive model is used. The data relating to the exchange rate, interest rate and bunker price are collect and calculated. As the conclusion drawn by the model, the bunker price risk has the most significant influence on the EBITDA, followed by the interest rate risk and the bunker price risk.

Some methods are introduced to help C shipping company get rid of such risks.

Collecting Bunker Adjustment Factor and Slowing down the sailing speed to avoid the rising bunker price. Collecting the Currency Adjustment Factor to get rid of the exchange rate risk.

In conclusion, it is essential for the shipping companies to be aware of the importance of risk identification to take measures to avoid the risks.

**Keywords:** Risk, Interest rate, Bunker price, Exchange rate, C shipping company

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## List of abbreviations

AWE 1	Asia/USEC and Gulf of Mexico & Central America Services 1
AWE 4	Asia/USEC and Gulf of Mexico & Central America Services 4
BAF	Bunker Adjustment Factor
BC	Bunker Cost
BP	Bunker Price
C	Capacity
CAF	Currency Adjustment Factor
D	Distance
DFC	Daily Fuel Consumption
EBITDA	Earnings Before Interest, Taxed, Depreciation and Amortization
ER	Exchange Rate
FC	Fuel Consumption
IR	Interest Rate
SD	Sailing Day
TFC	Total Fuel Consumption
V	Sailing Speed
VAR	Vector Auto Regression

## **Chapter 1 Introduction**

### 1.1 Background

Shipping industry is a risk-taking industry. There are a lot of risks the shipping enterprises are faced with. The shipping industry is a capital-intensive industry. With the development of the shipping enterprises and the increasing size of the ships, the shipping enterprises will invest more in building new ships, which means that the shipping enterprises will take more risk in ship investment. Furthermore, other risks, such as: currency exchange rate, bunker price, etc, also have the influences on the shipping enterprises. The shipping industry is full of uncertainty, and many factors will have the influence on the operating profit of the shipping enterprises.

Risk is an essential concern to all shipping enterprises, so the shipping enterprises should make efforts to manage the risks and to get rid of them. In the International society, there have been some accords, which help to control the risks the enterprises may have. The famous one is the Third Basel Accord. It is a International standard on market liquidity risk, bank capital adequacy and stress testing<sup>1</sup>. The Third Basel Accord introduces the risks the banks may be faced with, such as credit

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<sup>1</sup> [http://en.wikipedia.org/wiki/Basel\\_III](http://en.wikipedia.org/wiki/Basel_III)

risk, market risk and operating risk and sets up the capital requirement, leverage ratio and liquidity requirements. The Accord helps to reduce the banking risks. In terms of the shipping enterprises, there are lots of the risks they are faced with. The risks may influence the operating profit of the enterprise, so that it is essential for the shipping enterprises to get rid of such risks.

In China, some shipping enterprises have realized the importance of risks. They have taken varieties of measures to get rid of the risks brought by the fluctuation of the shipping market. For example, two companies co-operate to set up a new shipping route and operate together to reduce the risk arising from the change of the bunker price.

The dissertation is based on a typical Chinese shipping enterprise: C shipping company, which is one of the leading companies providing the container transport service. With the uncertainties, C shipping company suffered a huge loss in 2012. Based on this situation, three types of risks relating to operation of C shipping company will be concerned in this dissertation. They are the exchange rate between RMB and US dollars and Euro, the interest rate risk when making investment and the fluctuation of the bunker price.

The uncertainty of the shipping industry will have the effects on the management of the shipping enterprises, which may bring different risks to the shipping enterprises. It is important for C shipping company to identify the risks and to know to what extent each type of risks may influence the enterprises. Then C shipping company can take measures to avoid the risk to the largest extent.

## 1.2 The purpose of the dissertation

The main purpose of this dissertation is to analyze that to what extent the different types of risks may influence EBITDA of C shipping company and to recommend some solutions to reduce the risks. There are three types of risks C shipping company may be faced with, including the exchange rate between RMB and US dollars and Euro, the interest rate risk when making investment and the fluctuation of the bunker price. In the end, some methods will be introduced to help C shipping company to get rid of the risks.

The dissertation will identify the risks the shipping enterprise may be faced with. The trade gravity model, the Vector Auto Regression model (VAR model) and the Eviews software will be used to analyze to what extents different risks influence the Earnings Before Interest, Taxed, Depreciation and Amortization, which is so called EBITDA of C shipping company.

## 1.3 The framework

In Chapter 2, numbers of previous researches on the risks influencing the operating profit of shipping company are introduced. In Chapter 3, the risks the C shipping company may be faced with, including the exchange rate between RMB and US dollar and Euro, the interest rate and the bunker price, are analyzed respectively. In Chapter 4, the Vector Autoregressive model is used to check to what extent each type of risk has the influence on the EBITDA, of C shipping company and some solutions have been mentioned to get rid of the risks.

#### 1.4 Conclusion to be applied for C shipping company

According to the conclusion drawn from the VAR model, the fluctuation of bunker price has the most significant influence on the EBITDA of C shipping company, followed by interest rate and the exchange rate. To get rid of the bunker price risks, C shipping company may collect BAF when the bunker price has a significant rise. Furthermore, C shipping company may change the sailing speed to reduce the fuel consumption.

## **Chapter 2 Literature review**

In recent years, there are a lot of researches on the risks influencing the financial performance of shipping enterprises. The authors analyze the different types of risks which may influence the financial performance of shipping enterprises, such as investment risk, foreign currency exchange rate risk, credit risk, marketing risk, freight rate risk, bunker price risk, etc. Some of the researches are published in journals, and some of them are thesis, which are not published. The recent researches can be settled.

Investment is a big issue in the shipping industry. For a shipping enterprise, it is common for one shipping enterprise to buy a ship through borrowing money from a bank or other institutions. In this situation, such a shipping enterprise may be faced with the investment risk and the financial decision-making risk. Based on the situation of private shipping companies, Shi Shuai (2010) builds an indicator system including five indicators: enterprise qualification condition, enterprise financial status, project risk factor, shipping marketing risk and policy risk. The author uses the BP neural network evaluation model to develop an assessment model to analyze the shipping financial leasing risk. Deng Weiguo (2009) introduces the main financial risks when the enterprise is going to make a financial decision, including credit risk, interest rate risk and foreign exchange rate risk, and mentions some



measures to avoid the risks. According to Fan Yu (2009), the risks that the shipping enterprises may face with can be divided into two groups: the systematic risks and the unsystematic risks. The author uses the risk assessment model with variable weight to make quantitative analysis of the shipping investment risks, which can help the shipping enterprises to make the optimal decision under different market circumstance. In Liu Xiaodong (2007)'s article, several types of risks the shipping enterprise may counter with are listed. The author builds an assessment model based on the AHP model and the grey theory to assess the risks the A enterprise will have in the shipping leasing process.

In terms of the foreign currency exchange rate risk, it is one type of the risks that the Chinese shipping enterprises may have the good chance to be faced with. A lot of Chinese shipping enterprises calculate the operating cost and the freight rate in Chinese currency: RMB, while the currency in the international trade is settled in US dollars. Some theses emphasize the importance of avoiding the foreign currency exchange rate risks. Sun Liuyu and Tian Jianfang (2010) list the main foreign currency exchange rate risks for the shipping enterprises, including the trade risk, settlement risk and operational risk. The authors state the causes of the foreign currency exchange rate risks and introduce the measures to guide the shipping enterprises to get rid of such risks. In the same field, Han Shu (2000) analyzes the relationship between the fluctuation of the foreign currency exchange rate and the currency exchange rate risk in the shipping enterprises. The author makes the foreign currency exchange rate quantitative and emphasizes on the importance of forecasting the foreign currency exchange rate, then the author uses the neural network exchange rate forecast model and gives the advises on the strategic management.

Zhang Wei (2006) analyzes the appraisal methods of the credit of the shipping enterprises and the credit risk of the shipping enterprises. The author provides the whole process of the credit management of the shipping enterprises with the analysis methods and decision-making tools to help the shipping enterprises to build up their own credit management system.

The fluctuation of the freight rate is always the main concern for all shipping enterprises to operate and control the vessels, which they are holding. According to Li yunguang (2009), it can be concluded that the volatility of the Baltic freight rate is the main risk to the shipping enterprises through the peaks over threshold (POT) model and the sensitiveness analysis. The author introduces some ways to avoid such risks, including index floating method, freight hedging and freight forward agreement.

Risks may arise when the shipping enterprises are willing to make operational decisions, for example, when the shipping enterprise wants to merge and acquire another company, the enterprise may meet with some risks. Ma Shiqun (2007) divides the merger and acquisition risk into the risk before merger and acquisition, the risk during the merger and acquisition and the risk after the merger and acquisition. The author forecasts the cash flow in the future and considers the influence of the cycling fluctuation of the shipping industry. In the thesis, the value of the target enterprise in merger and acquisition is assessed through the calculation of the net present value and the enterprise weight model.

Some theses analyze the risks of the shipping enterprise in a specific field. Qian Yuan (2008) focuses his eyes on the tanker shipping enterprises. The risks the tanker enterprises may be faced with are divided into operational risk, environment

risk and safety risk. As the basis to assess the operational risks in the tanker shipping enterprises, the indicator assessment system is built up. Through the fuzzy comprehensive evaluation model, the level of risks in the tanker shipping enterprises is accurately evaluated to help the manager of the enterprise to make the right decision.

Hu Huihong and Hu Hao (2009) analyze the risk management of China Shipping Container Lines based on the value chain. The article uses the Hines value chain model to make systematic analysis of the risks in the shipping enterprises. The risks are divided into interior risk, inter-enterprises risk and exterior value chain risk. Under the background of China Shipping Container Lines, the AHP model and the fuzzy assessment model are used in order to analyze the risk status of China Shipping Container Line.

Yin Enjie (2010) combines the qualitative analysis with the quantitative analysis, based on the China Shipping Group, to analyze the risk management of accounts receivable through using the risk management theory. The article concludes the experience of the risk management of accounts receivable of China Shipping Group and analyzes the operation of the risk management of accounts receivable of China Shipping Group.

The shipping enterprises should take the volatility of the bunker price into consideration all the time. Bunker is a main element of shipping industry. Ma Hui (2008) states the relationship between the fluctuation of the bunker price and the risks of shipping industry and discussed the importance and the necessity to get rid of the bunker price risk. The article lists several methods to do the bunker price hedging to help the shipping enterprises to avoid the risk and introduced cases to

explain the usage of hedging.

The management and strategy of the financial decision-making is very important for any shipping enterprise, so the shipping enterprises should focus on the risks they may be faced with when they are going to make a financial decision. Ye Nan (2006) lists some main financial decision-making risk of shipping enterprises, including the seasonal risk of the freight rate, bunker price risk, foreign currency exchange rate risk and the interest rate risk. The author introduces the VAR (value at risk) model and the pressure test method to analyze all the financial decision-making risks and provides some ways to avoid the risks. Huang Chengliang (2004) builds up a basic framework of financial risk management of the shipping enterprises and makes a both qualitative analysis and quantitative analysis on the shipping risks in the way of risk recognition and risk forecast. Under the background of shipping enterprises in China, Wang Xiaolian (2005) stats some problems in the financial risk management of shipping enterprises in China, including the fund raising issue, foreign currency exchange rate problem and the interest rate risk and studies on the interior environment development of the financial risk management of Chinese shipping enterprises. Liu Yongqing (2007) introduces free cash flow into the study on the financial risk management of shipping enterprises and states the interior relationship between the free cash flow and the financial risks. The author finds several measurable financial risks in the flow of free cash, including the trading quantity, freight rate, bunker price, foreign currency exchange rate and interest rate. The author uses the Vector Autoregression (VAR) model to check the relevancy between the risks and the free cash flow of a shipping enterprise to evaluate which risk has a strongest relationship with the free cash flow. As a result, the amount of transportation has a significant impact on the free cash flow, and the author has mentioned some methods to help the shipping enterprise to get rid of the main

financial risks.

A lot of articles look at the overall risks of a shipping enterprise. The risks of shipping enterprises are recognized in the article of Xu Jianhao and Li Zan, and all the risks are divided into interior risks (including the investment and leasing risk, operation management risk and human resource risks) and exterior risks (including the natural risk, political risk, marketing risk and financial risk). The AHP-fuzzy comprehensive evaluation model is applied to calculate the overall risk value of A shipping enterprise, and the value of risk is 0.39, which means the overall risk level is comparatively low. Li Huimin (2009) introduces main risks of the shipping enterprises, including the strategic risk, marketing risks, financial risk, investment risk, human resource risk and ship management risk and emphasizes on the importance of getting rid of the risks. The AHP- fuzzy comprehensive evaluation model is used to evaluate the value of risk of shipping enterprises in the article of Chang Guibin (2008), and the risk assessment model of shipping enterprises is used to give the rank to all risks to conclude the most significant risk to the shipping enterprises: the ship management risk. According to all the risks the shipping enterprises faced with, Zhang Qian (2003) introduces some measures against the investment risk, competition risk, foreign currency exchange rate risk and marine accident risk. Wang Shen (2009) makes a research on the framework of all risk management in shipping enterprises, and introduces some main articles on the risk management, including the Basel agreement, COSO framework of overall risk management and 3C overall risk management standard to mention the importance of risk management. The author builds up a framework of all risk management in shipping enterprises through some methods, for example, forward freight agreement and hedging process, to help the shipping enterprises to manage the risks effectively. Li Jiahua (2005) thinks the control of risks as an important issue. The author

analyzes the interior relationship between the development strategy, finance and investment of the shipping enterprises and analyzes the main factors, which will influence the seasonality of Chinese shipping industry. From the view of overall planning and forecasting, the strategies the shipping enterprises should carry out to make sustainable development and to control the overall risk were introduced: reverse operation and investment portfolio. Lin Zhizhong (2011) emphasizes the importance to appraise the risks of shipping enterprises, and the principle and the methods of risk assessment were introduced. The risks are made quantitative to calculate the tolerance level of the risks and the methods to avoid the risks were introduced. Deng Yi (2006) analyzes the operational risks, ship investment risks and the credit risks of shipping enterprises on the basis of the overall risk management of shipping enterprises. The author uses quantitative methods to assess the main risks of the shipping enterprises and states some measures to avoid the risks, for instance, the shipping enterprises can introduce some advanced risk management theory to find out a suitable risk management technology to build up a new risk management system, which can lead the shipping enterprises to win the competition in the shipping industry. Wang Lujun (2005) thinks that the strategic risk, operational risk, financial risk, human resource risk, legal risk and the accident risk are the main risks the shipping enterprises are faced with and illustrates the ways to manage all the risks. The author takes Xiamen Ocean Shipping Company as an example to emphasize the importance of risk management. The risks in the shipping market are concluded in the article of Zhang Beiping and Li Qing (2006), including the political risk, legal risk, interest rate risk, foreign currency exchange rate risk, cost risk and competitive risk. The author thinks that the best way to get rid of the operational risk is to make the revenue of the shipping enterprise stable to the greatest extent through fixing the freight rate in the International Exchange and other freight rate exchange to reduce the market risk.

As is seen from the theses mentioned, some of the authors look at the overall risk management of shipping enterprises while some put more emphasizes on a specific field, such as investment risk. In the Research on the Risks Influencing EBITDA of C shipping company, to what extent the different types of financial risks may influence C shipping company will be analyzed and some solutions to get rid of the risks will be recommended.

It is important to decide which methodology is going to be used to reach the research purpose. Among all the theses mentioned, the AHP-fuzzy comprehensive evaluation model is always used. The AHP-fuzzy comprehensive evaluation model is used to help the decision maker to find the most suitable solution to the problems defined through weighing all the factors. Research on the Risks Influencing EBITDA of C shipping company aims to find out the extents types of risks will influence C shipping company, so it is obvious that the AHP-fuzzy comprehensive evaluation model is not suitable. In the article of Liu Yongqing (2007), the Vector Autoregression (VAR) model is used to check the relevancy between the risks and the free cash flow of a shipping enterprise to evaluate to what extent the risks will influence the free cash flow of a shipping enterprise. The Vector Autoregression (VAR) model is a statistical model used to capture the linear interdependencies among multiple time series.<sup>2</sup> The Vector Autoregression (VAR) model is decided to be used in the Research on the Risks Influencing EBITDA of C shipping company to help to find out the extent that each type of risk influences the EBITDA of C shipping company.

There are some problems existing in the study of financial risks of shipping

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<sup>2</sup> [http://en.wikipedia.org/wiki/Vector\\_autoregression](http://en.wikipedia.org/wiki/Vector_autoregression)

enterprises. Firstly, not all types of risks can be quantitative, for example, the policy risks, the strategy risks, etc. In using the methodology, the data accessibility is very important.

Secondly, not all types of risks can be concluded in the thesis, which is very difficult. To reflect the financial risks C shipping company is faced with in its performance to the biggest extent, some main types, which can also be quantitative, are chosen, including the exchange rate between RMB and US dollars and Euro, the interest rate and the bunker price.

Thirdly, the recent researches provide useful information and introduce some helpful methodology. But we can see from the articles, there are few researches on the question that to what extents different risks influence the EBITDA of a shipping enterprise, the thesis will take C shipping company as an example to study on this topic.



### **Chapter 3 Risk identification and analysis of C shipping company**

The dissertation takes C shipping company as an example to analyze the risks the container shipping enterprises may be faced with. The information and the EBITDA of C shipping company will be introduced and indicated in the following sections. Meanwhile, three types of risks will be identified as the fluctuation of exchange rate between RMB and US dollars, the volatility of interest rate based on Chinese background and the fluctuating bunker price. Each type of risks will have a different influence on the EBITDA of C shipping company.

#### **3.1 Introduction of C shipping company**

C shipping company was established in 1998, which is a wholly-owned subsidiary of its parent company, which is so-called P company. C shipping company mainly participates in the International container transport services. So far, C shipping company is a leading container transport provider in both China and the world. According to the fleet statistic rankings based on total TEU capacity operated by the container shipping companies, C shipping company is at the leading level. As a global leading container shipping company, C shipping company provides it container transport service at hundreds of ports in more than 50 countries and regions,

and it operates its container vessels on 76 International routes, 10 International feeders, 21 China coastal routes and 67 Pearl River Delta and Yangtze River feeders. Moreover, C shipping company has 400 agencies and branches all over the world to provide the container shipping service to the local clients.

With the growing trading demand, the volumes of cargo transported show a trend of growing from 2004 to 2012, which can be shown in Figure 1.

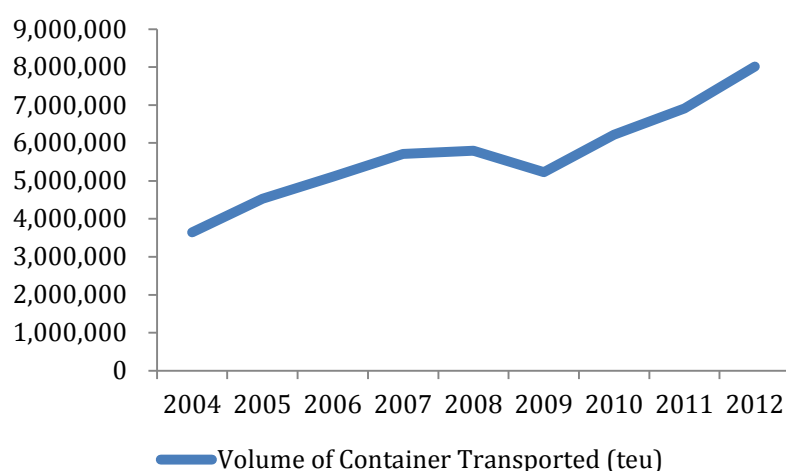


Figure 1 - Volumes of container transported of C shipping company from 2004 to 2012

Source: P company annual report and interim report 2004-2012

As shown in the Figure 1, the increase of volume of container transported may bring more profit to C shipping company. In terms of the financial performance, the EBITDA, which is also called the operating profit, is chosen to show the financial performance of C shipping company. EBITDA is commonly used to reflect a operating situation of a company. It excludes some other factors, such as interest, tax, etc, which may not reflect the operating performance of a company, and make it confused. Figure 2 shows the EBITDA of C shipping company since 2004.

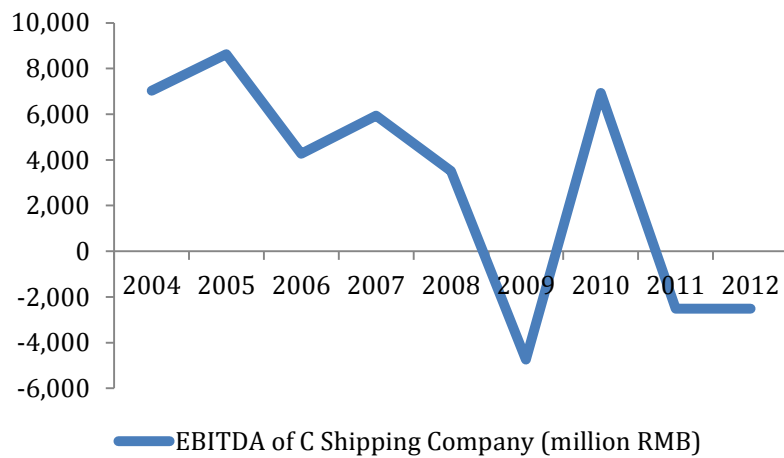


Figure 2 - EBITDA of C shipping company from 2004 to 2012

Source: P company annual report and interim report 2004-2012

Figure 2 shows a fluctuation of EBITDA of C shipping company from 2004 to 2012. It indicates that there appears some other factors may influence the EBITDA of C shipping company. In the following sections, some types of factors that C shipping company can not control, which is called the risks, will be analyzed.

### 3.2 Identification of risk in C shipping company

#### 3.2.1 Brief introduction of the risks

Shipping is a risk-taking industry, and the EBITDA of C shipping company may be influenced by many risk issues. Risk means uncertainty, and risk may bring profit, loss, or other financial results to a company. During the operation of a shipping enterprise, it may meet with variety kinds of accidents, and the shipping enterprise

can not predict the probability and the impact of such accidents. The risks may have the effect on the operational activities, which may influence the shipping enterprise to realize its financial targets.

It is easy to understand that the difference between the expected target and the results in reality under a certain circumstance during a certain period of time is called risk. As can be seen from Figure 1 and Figure 2, although the volumes of container transported have increased these years, the EBITDA of C shipping company shows a fluctuation, which means there are some other factors influencing the EBITDA of C shipping company. The risks the shipping enterprises are faced with can be divided into marketing risks, operational risks and others. Marketing risks include the demand and supply, the situation of global economy, etc. In terms of the operational risk, it contains the volatile earning and cost. The purpose of the dissertation aims to find out the risks affecting the operational profit, EBITDA, of C shipping company, so that the operational risks are chosen as the main risks, which may influence the EBITDA of C shipping company. As the marketing risks are excluded, the risks that C shipping company may be faced with will be analyzed under the background of a fixed market situation and a fixed freight rate, which means the balance between demand and supply remains unchanged.

Although the freight rate is fixed, there are also some other risks may have an influence on the EBITDA of C shipping company. Here, three types of risks C shipping company may be faced with will be listed and analyzed, so called exchange rate between RMB and US dollars, the interest rate when making investment and the fluctuation of the bunker price.

### 3.2.2 Exchange rate between RMB and US dollars and Euro

Exchange rate stands for the ratio one currency converting another currency in a different country. Due to the different countries using different types of currencies and each type of currency having its own value, a ration to exchange another currency should be made, which is so called exchange rate. Furthermore, the foreign currency exchange rate will be influenced by many other issues, for instance, the government policy, the balance of currency demand and supply, etc.

Each currency has its own value and the value may be changed all the time. Because of the changing currency value, the ratio between the two specific types of currency is volatile. As shipping is a global industry, some of the freight of C shipping company are calculated in foreign currency, usually in US dollars and Euro and while the turnover is settled in Chinese currency RMB. The fluctuation of the exchange rate may have the influence on the revenue of C shipping company.

There are three factors being considered in the definition of exchange rate risk, which can be listed as local currency, foreign currency and time. If a deal happens including two different or more types of foreign currency at a certain moment, there is no foreign currency exchange rate risk existing because the exchange rate is fixed. If a deal happens including two different or more types of foreign currency over a period of time, there might be a foreign currency exchange rate risk, because of the changing exchange rate. It can be concluded that the longer the period over a deal, the higher probability a company may have to take a risk.

In terms of C shipping company, most of freight is calculated in International trading

currency – US dollars and the freight of European trades is calculated in Euro. As is mentioned, C shipping company several International routes. The fluctuating exchange rate between RMB and US dollars and Euro may have a remarkable influence on EBITDA of C shipping company.

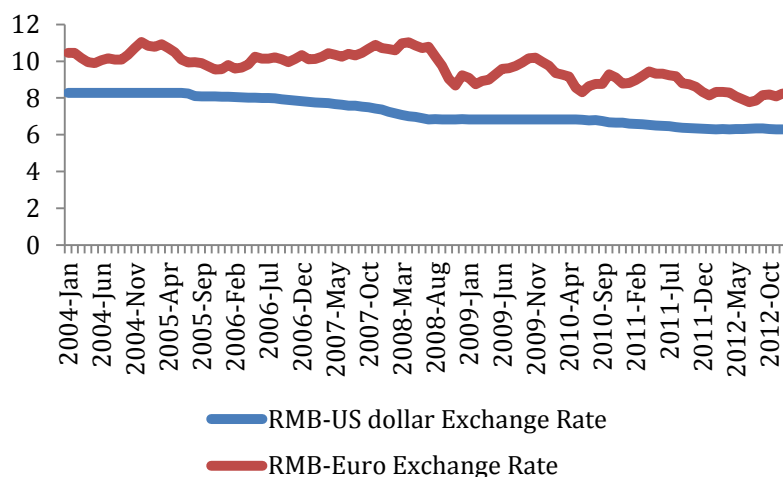


Figure 3 - Exchange rate between RMB and US dollar and Euro from 2004 to 2012

Source: Clarkson SIN and Website of China Bank

Here, two ways in which the exchange rate risk may have the impact on EBITDA of C shipping company are listed. The first one is the freight settlement in the International trade. Take the service Asia/USEC and Gulf of Mexico & Central America Services 1 (AWE1) of C shipping company as an example, in which the freight rate is calculated in US dollars, a fully loaded container vessel carrying is arranged to be transport from Ningbo to Savannah, and it takes 31 days to run this voyage as scheduled. We suppose the freight was collected, and the voyage started at September 2012 and arrived at Savannah at October 2012.

Table 1 - Influence on AWE service due to the exchange rate risk

Exchange rate (Sep. 2012)	Exchange rate (Oct. 2012)	Freight rate supposed (per teu)	Fright loss (RMB per teu)	Capacity (teu)	Total loss (RMB)
6.34	6.31	1000	30	4250	127,500

In Table 1, it indicates that, in the long term, this kind of loss will have a negative effect on turnover of C shipping company. On the other hand, if the ratio of RMB over one US dollars rises during the period of transportation, C shipping company may be beneficial under such kind of circumstance. Thus the fluctuation of the exchange rate between RMB and US dollars, also called the exchange rate risk will make the EBITDA of C shipping company up and down unexpectedly.

Besides the freight settlement in the International trade, the second way in which the changing exchange rate risk may influence the EBITDA of C shipping company can be considered as settlement in the newbuilding and sale and purchase contract. In December 2007, C shipping company introduced 16 container vessels (4250 TEU each) from a foreign company, which was settled in US dollars. The total payment was 108,128million US dollars, which was paid by installment. C shipping company will pay the whole amount of money over five periods (each period paid 20%). Seven of the 16 container vessels were delivered during September 2011 and December 2011, and the rest were delivered during February 2012 and June 2012. Since December 2007, it shows a significant decline in the ration of RMB over one US dollar, from 7.37 to 6.33 in December 2011. Because such kind of decline, C shipping company might save the cost, which brought the good news to the EBITDA of C shipping company.

As an International shipping company, C shipping company has 400 agencies and branches globally, and C shipping company provides it container service at 159 ports in more than 48 countries and regions. The freight settlement in the International trade, the sale and purchase of second-hand vessel, and the payment of newbuilding contract are always paid in International trade currency. We can draw the conclusion that the fluctuating exchange rate between RMB and US dollars and Euro must bring the exchange rate risk to C shipping company. The EBITDA of C shipping company will be influenced by the volatile exchange rate between RMB and US dollars and Euro.

### 3.2.3 Interest rate risk when making investment

Interest rate is the ratio of interest over the loan capital in a certain period of time. Interest rate is the interest level of the unit currency in the unit time, which stands for the amount of the interest. The interest rate in one country is controlled by the State Central Bank. In China, the interest rate of RMB is set by the China Bank. Interest rate is regarded as an important tool to regulate and control the macro-economy in almost all countries. The economic status of one country is not stable, leading to the fluctuation of the interest rate.



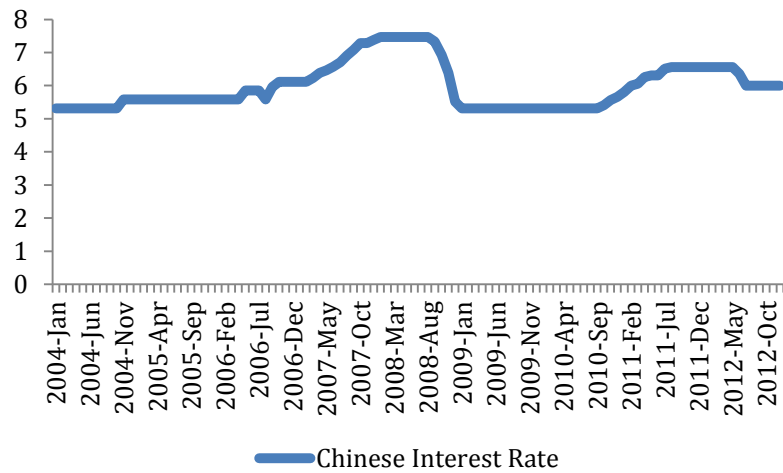


Figure 4 - Chinese Interest rate from 2004 to 2012

Source: Clarkson SIN and Website of China Bank

Shipping is a capital-intensive industry, and it costs the shipping company huge amount of money to purchase and to newbuild a vessel. Usually, C shipping company lends a loan from either one commercial bank or a commercial bank group. The interest rate of a loan borrowed from commercial bank is floating, which means the interest rate is not fixed over the time of loan. Because of the interest rate may be changed during the period of repayment of the loan.

As an International shipping company, enlarging the container vessel fleet is very important to C shipping company. The purchase of a second-hand vessel and making an order of newbuilding vessels happens from time to time. In conclusion, it is very important for C shipping company to decide when to make investments on the vessels. As is mentioned, shipping is a capital-intensive industry, it is impossible for one shipping company to pay all the money at once, and it is inevitable that there is always a loan involved when there is a decision made to invest on the container vessel fleet.

In May 2009, the bank of China announced that the bank of China Shanghai branch would provide a 20 billion RMB loan to C shipping company with bank of China Hong Kong Branch in the following a few years. It was a loan provided by a commercial bank group. According to the arrangement of the loan, 1.08 billion RMB would be lent to C shipping company aiming to invest on the building of 28 container vessels during 2010 to 2012. Furthermore, about 7 billion RMB would be lent to provide the current capital to C shipping company to supplement the daily expense of C shipping company. 90% of the loan would be provided by the bank of China Shanghai branch. It was huge amount of loan, and the interest rate fluctuated from 2010 to 2012, which might have the unexpected impact on the EBITDA of C shipping company.

Until 2011, C shipping company operated 157 vessels, compared to the 115 vessels in 2004. Although part of the container vessels were chartered from other shipping owners, it also states a remarkable increase in the fleet scale, so that C shipping company has lent huge amount of money from the commercial banks and the bank groups. With the fluctuation of interest rate, the different amount of interest at different time will have different impact on the EBITDA of C shipping company. The conclusion can be drawn here that the interest rate risk will influence the EBITDA of C shipping company.

#### 3.2.4. The fluctuation of the bunker price

Bunker cost is one of the main components of the operating cost of a shipping company. As a International shipping company, C shipping company operates 76

International routes and 10 International feeders globally. During a trans-ocean voyage, it usually takes one to two months, sometimes even longer, to complete a shipment. In the period of sailing, several ports may be chosen to bunker the container vessels. Bunkering at different ports at different time may have a different influence on the EBITDA of C shipping company. It can be said that the fluctuating bunker price may bring the bunker price risk to the EBITDA of C shipping company.

It is easy to understand that the bunker price is closely related to the oil price. There are some factors, which may influence the price of bunker. Firstly, with the development of global economy, the demand of oil keeps improving, which leads to the higher bunker price. Secondly, the cost of producing oil is rising. Furthermore, there are some other issues causing the fluctuation of bunker price.

The shipping industry can not exit without bunker, and the fluctuating bunker price will closely linked to the operating cost and EBITDA of C shipping company.

Figure 5 shows the 380 cst bunker price, which is the main fuel cost of shipping enterprises, at three main bunkering ports, stated as Rotterdam, Singapore and Busan.

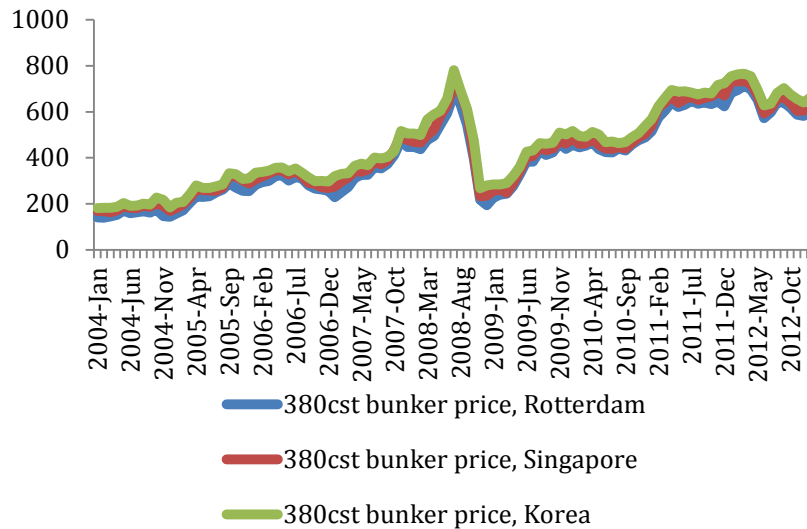


Figure 5 - Bunker price (US dollar per tonne) at different ports from 2004 to 2012

Source: Clarkson SIN

It is clear that the trend of the changing bunker price at Rotterdam, Singapore and Busan is the same, showing a significant fluctuation. In March 2008, the 380 cst bunker price arrived the peak almost at 800 US dollars per tonne, and then it showed a dramatic drop during March 2008 and 2009 January. Since then, the 380 cst bunker price has been climbing steadily. Among the three listed ports, the 380 cst bunker price at Rotterdam is the cheapest while the 380 cst bunker price at Busan is the most expensive. It is the signal that there has the possibility that C shipping company may choose Rotterdam as a port of bunkering rather than Busan if the vessel calls at both the ports in one specific route, which can help C shipping company reduce the bunker price as much as possible.

As is mentioned, the reliance of EBITDA of C shipping company on the fluctuating bunker price can not be ignored. Table 1 shows the ratio of bunker cost over the operating cost of C shipping company.

Table 2 - Ratio of bunker price over operating cost of C shipping company from 2007 to 2012

Year	Operating Cost (million RMB)	Bunker Cost (million RMB)	Ratio (Bunker Cost over Operating Cost)
2007	39,832	8,023.454	20%
2008	40,291	10,327.43	26%
2009	32,251	6,161.386	19%
2010	39,383	8,157.97	21%
2011	43,920	11,147.33	25%
2012	47,032	12,386	26%

Source: P company annual report from 2007 to 2012

Table 2 shows the operating cost, bunker cost and the ratio of bunker cost over operating cost from 2007 to 2012. It can be seen that the ratios since 2007 are higher than 20 percent, except 2009. Due to the declining bunker price since the end of 2008, it shows a drop of bunker cost in 2009.

The co-relationship between bunker price and EBITDA is closed. The fluctuating bunker price has a significant influence on C shipping company. So the volatility of bunker price will bring the bunker price risk to C shipping company.

### 3.3 Summary

According to the analysis above, the exchange rate risk, the interest rate risk and the bunker price risk are more or less influencing the EBITDA of C shipping company.

In Chapter4, the VAR model will be introduced and will be used to analyze that to what extent each type of the risk influences the EBITDA of C shipping company. Then some methods to avoid the risks will be mentioned.

## **Chapter 4 Data collection and risk analysis based on VAR model**

Three types of risks, which have influence on the EBITDA of C shipping company have been defined and analyzed in chapter 3. It is important for C shipping company to know which risks has the most significant effect on its operating profit, and C shipping company can take effective measures to get rid of such kind of risks. Here, the Vector Autoregressive model is introduced to help C shipping company analyze to what extent different types of risks have the impact on the EBITDA of C shipping company.

### 4.1 Introduction of the models

The Vector Autoregressive model (VAR), which is an econometric model, was proposed by Christopher Sims in 1980. The model is not based on economic theory, but to make the regression of lagged value one endogenous variable influencing the other endogenous variables in the model, which helps to estimate the dynamic relationship among all the endogenous variables. In addition, there is no constraint condition including the VAR models.

There are two important parameters in the VAR model. One is the number of endogenous variables, the other is the maximum lag intervals for endogenous. The function of VAR model containing  $n$  endogenous variables lagged  $k$  periods can be shown as follows:

$$Y_t = c + A_1 Y_{t-1} + A_2 Y_{t-2} + \dots + A_k Y_{t-k} + e_t$$

In the function,  $c$  stands for  $(n \times 1)$  constant vector,  $A_k$  means the  $(n \times n)$  matrix, and  $e_t$  is the  $(n \times 1)$  error vector.

In economy, the relationship between some variables is significant, but this kind of relationship is not evitable. It is a common question in the econometrics that whether the fluctuation of one variable is the reason for the change of the other variables. The Granger causality test is introduced to judge the relationship of two variables.

In essence, the Granger causality test is to test that whether a lagged variable of a variable can be introduced to the function of another variable. If one endogenous variable is influenced by other lagged variables, it is said that the variables have the Granger causality co-relationship.

After the Granger causality test, the dynamic relationship among all the endogenous variables can be analyzed. Through the impulse response function, the influential relationship can be analyzed on the basis of time series, which means it shows that how one endogenous variable affects other variables.

Besides the impulse response function, there is another one called the variance decomposition can be used to analyze the influential extent. The variance decomposition provides the information that the importance of one endogenous



variable influencing on the other endogenous variables.

Through the VAR model, to what extent each type of risk may influence on the EBITDA of C shipping company.

## 4.2 Data collection

### 4.2.1 Exchange rate

The exchange rates between RMB and US dollars and Euro have been chosen as the indicator to reflect the exchange rate risk to the EBITDA of C shipping company.

Table 3 - Exchange rate between RMB and US dollar and Euro from 2004 to 2012

Year	RMB-US dollar	RMB-Euro	Year	RMB-US dollar	RMB-Euro
2004 1st	8.2870	10.1615	2009 1st	6.8328	9.1049
2004 2nd	8.2766	10.4047	2009 2nd	6.8293	9.9349
2005 1st	8.2765	10.6360	2010 1st	6.8251	9.0739
2005 2nd	8.1133	9.7706	2010 2nd	6.7157	8.8934
2006 1st	8.0314	9.8771	2011 1st	6.5430	9.1780
2006 2nd	7.9156	10.1441	2011 2nd	6.3799	8.8194
2007 1st	7.7186	10.2496	2012 1st	6.3076	8.1833
2007 2nd	7.4956	10.5754	2012 2nd	6.3172	8.0498
2008 1st	7.0589	10.8059			
2008 2nd	6.8371	9.6271			

Source: Clarkson SIN and Website of Bank of China

Table 3 shows the exchange rate. The data comes from Clarkson SIN and website of bank of China. Here, the weighted average method is used to calculate the

overall exchange rate. In the dissertation, the freight rate is supposed to be unchanged, so that the volumes of container transported in the Euro zones and US dollar zones respectively since 2004 are considered as the weight.

Table 4 - The volumes of container transported (teu) in US dollar zone and Euro zone since 2004

Year	US dollar zone	Euro zone	Year	US dollar zone	Euro zone
2004	2,456,307	761,013	2009	2,726,641	1,193,422
2005	2,817,600	1,002,561	2010	3,391,664	1,287,481
2006	3,060,413	1,208,507	2011	3,586,683	1,475,582
2007	3,239,478	1,362,440	2012	4,068,267	1,792,021
2008	2,967,407	1,527,980			

Source: P company annual report from 2004 to 2012

Based on the volumes of volumes of container transported (teu) shown in Table 4, the weight of US dollar exchange rate and Euro exchange rate can be calculated in Table 5.

Table 5 - The weight of US dollar and Euro exchange rate since 2004

Year	Weight (US)	Weight (Euro)	Year	Weight (US)	Weight (Euro)
2004	0.7635	0.2365	2009	0.6956	0.3044
2005	0.7376	0.2624	2010	0.7248	0.2752
2006	0.7169	0.2831	2011	0.7085	0.2915
2007	0.7039	0.2961	2012	0.6942	0.3058
2008	0.6601	0.3399			

According to the weights calculated in Table 5, the comprehensive exchange rate can be calculated.

Table 6 - The overall exchange rate since 2004

Year	Exchange Rate	Year	Exchange Rate
2004 1st	8.7227	2009 1st	7.5245
2004 2nd	8.7800	2009 2nd	7.7748
2005 1st	8.8957	2010 1st	7.4439
2005 2nd	8.5482	2010 2nd	7.3149
2006 1st	8.5539	2011 1st	7.3111
2006 2nd	8.5464	2011 2nd	7.0909
2007 1st	8.4679	2012 1st	6.8812
2007 2nd	8.4074	2012 2nd	6.8470
2008 1st	8.3325		
2008 2nd	7.7854		

The exchange rate calculated in Table 6 will be used as the indicator to reflect the exchange rate risk influencing EBITDA of C shipping company in VAR model.

#### 4.2.2 Interest rate

The interest rate when lending a loan from the bank set by the Bank of China on one-year basis has been chosen as the indicator to reflect the interest rate risk to EBITDA of C shipping company. The data of interest rate since 2004 has been collected on the semi-year basis.

Table 7 - Interest rate since 2004

Year	Interest Rate	Year	Interest Rate
2004 1st	5.31	2009 1st	5.31

2004 2nd	5.4	2009 2nd	5.31
2005 1st	5.58	2010 1st	5.31
2005 2nd	5.58	2010 2nd	5.4267
2006 1st	5.67	2011 1st	6.1246
2006 2nd	5.958	2011 2nd	6.5517
2007 1st	6.315	2012 1st	6.5267
2007 2nd	7.1108	2012 2nd	6
2008 1st	7.47		
2008 2nd	6.8513		

Source: Clarkson SIN and Website of Bank of China

Table 7 shows the interest set by Bank of China. The data comes from Clarkson SIN and website of bank of China.

#### 4.2.3 Bunker price

As is mentioned, bunker price is a main component of the operating cost of C shipping company. The fluctuation of bunker price will have an impact on the EBITDA of C shipping company. C shipping company operates its container vessels on 76 International routes, 10 International feeders, and the vessels call at hundreds of ports all around the world, so that it is difficult to decide at which port the bunker price will be used as an indicator of bunker price risk to C shipping company.

As a result, the weighted average method is introduced here to calculate the bunker price. The 380 cst bunker prices at eight ports, named as Rotterdam, Singapore, Los Angeles, Genoa, Panama, Busan, Hong Kong and Fos, have been taken into consideration, as these ports are the main bunkering ports around the world.

Table 8 - Bunker price (US dollar per tonne) at eight ports since 2004

Year	Fos	Rotterdam	Singapore	LA	Genoa	Panama	Busan	HK
2004 1st	159.97	151.27	173.87	173.54	165.75	169.31	187.86	187.20
2004 2nd	166.89	159.26	186.78	199.33	173.17	190.80	203.10	204.76
2005 1st	215.01	204.34	230.22	233.51	220.85	232.46	245.50	244.35
2005 2nd	272.78	263.62	293.59	293.13	280.93	293.25	306.68	306.01
2006 1st	319.40	304.01	329.28	334.55	320.36	330.84	345.90	344.01
2006 2nd	297.95	282.07	297.09	307.37	302.40	308.65	316.66	311.22
2007 1st	301.16	286.18	319.31	331.48	310.20	313.86	348.38	337.72
2007 2nd	421.26	403.95	426.34	431.85	426.01	421.02	442.29	436.68
2008 1st	512.44	498.93	528.35	549.25	518.27	534.90	570.33	543.05
2008 2nd	468.68	444.89	482.90	499.83	474.49	508.33	518.81	491.85
2009 1st	319.78	282.89	300.26	304.08	300.35	315.23	327.85	314.18
2009 2nd	468.52	424.74	443.48	446.15	448.28	448.03	471.93	453.19

2010 1st	485.73	447.45	464.09	464.43	467.36	474.53	497.35	474.78
2010 2nd	482.28	453.00	464.19	473.23	472.11	471.95	489.74	477.75
2011 1st	608.26	598.50	626.88	636.14	621.67	635.31	653.99	643.65
2011 2nd	656.30	637.38	667.01	675.59	666.70	662.34	693.78	682.48
2012 1st	689.34	668.42	697.44	709.42	695.83	690.90	726.96	718.64
2012 2nd	632.25	610.85	630.68	653.32	637.71	643.77	665.43	646.48

Source: Clarkson SIN

The 380 cst bunker prices at eight ports are stated in Table 8. Then it is important to determine the weight for each bunker price at every single port. In a voyage, the fuel consumption can be calculated based on the formula:

$$FC = k * \Delta^{2/3} * v^3$$

FC – fuel consumption of the container vessel

k - a coefficient relating the container vessel

$\Delta$  - the dead weight tonnage of the container vessel

v - speed of the container vessel

It is clear that the sailing speed has the most significant influence on the fuel consumption during a voyage. So the speed of a voyage is determined as the weight to calculate the bunker price.

Numbers of container services of C shipping company, which call at the eight bunkering ports listed, have been listed. From the C shipping company website, the sailing schedule of these services and the number of days that vessels stay at port can be found. Then the sailing days can be calculated as:

$$\text{Sailing Days} = \text{Total Transit Time} - \text{Time Spent in Port}$$

The software BLM-shipping is used to calculate the distance of a service. After that, the speed of a voyage can be calculated as:

$$\text{Speed (knots)} = \text{Distance} / (\text{Sailing Days} * 24)$$

	A	B	C	D	E	F	G
1	Service	Route	Transit Time	Time at port	Sailing time	Distance	Speed
2	Transpacific						
3	AWE 1	Ningbo-Shanghai-Busan-Panama-NewYork-Wilmington-Savannah-Qingdao-Shanghai-Ningbo-Yokohama-Lazarocardenas-Panama-NewYork-	63	4	59	21653.8	15.29
4	AWE 2	HongKong-Yantian-Kaohsiung-Shanghai-Busan-Panama-Savannah-	63	6	57	22340.9	16.33
5	AWE 3	Singapore-Hochiminh-Shekou-Hongkong-Yantian-Singapore-Suez-NewYork-Norfolk-Savannah-Suez-Yantian-Ningbo-Shanghai-Busan-Panama-Savannah-Norfolk-	63	3	60	22881.1	15.89
6	AWE 4	Hongkong-Yantian-Ningbo-Shanghai-PrinceRupert-Vancouver-Seattle-Busan-Shanghai-Ningbo-Xiamen-Panama-Panama-Colon-Houston-Panama-Busan	42	6	36	12538.8	14.51
7	AWE 6	Qingdao-Shanghai-Kwangyang-Busan-LongBeach-Oakland-Seattle-Tokyo-Qingdao-Ningbo-Shanghai-Busan-Prince Repert-Seattle-Portland-Kaohsiung-Yantian-Shekou-Shanghai-Busan-LongBeach-Oakland-Busan-Xiamen-Hongkong-Yantian-Tacoma-Vancouver-Tokyo-Nagoya-Kobe-Xiamen-Hongkong-Yantian-Shanghai-LongBeach-Oakland-Tokyo-Nagoya-	42	7	35	12640.8	15.05
8	CPNW	Prince Rupert-Vancouver-Seattle-Busan-Shanghai-Ningbo-Xiamen-Panama-Panama-Colon-Houston-Panama-Busan	42	6	36	12538.8	14.51
9	Gulf of Mexico	Qingdao-Shanghai-Kwangyang-Busan-LongBeach-Oakland-Seattle-Tokyo-Qingdao-Ningbo-Shanghai-Busan-Prince Repert-Seattle-Portland-Kaohsiung-Yantian-Shekou-Shanghai-Busan-LongBeach-Oakland-Busan-Xiamen-Hongkong-Yantian-Tacoma-Vancouver-Tokyo-Nagoya-Kobe-Xiamen-Hongkong-Yantian-Shanghai-LongBeach-Oakland-Tokyo-Nagoya-	42	7	35	12640.8	15.05
10	CAX	Qingdao-Ningbo-Shanghai-Busan-Prince Repert-Seattle-Portland-Kaohsiung-Yantian-Shekou-Shanghai-Busan-LongBeach-Oakland-Busan-Xiamen-Hongkong-Yantian-Tacoma-Vancouver-Tokyo-Nagoya-Kobe-Xiamen-Hongkong-Yantian-Shanghai-LongBeach-Oakland-Tokyo-Nagoya-	42	7	35	12621.0	19.3
11	HPNW	Qingdao-Ningbo-Shanghai-Busan-Prince Repert-Seattle-Portland-Kaohsiung-Yantian-Shekou-Shanghai-Busan-LongBeach-Oakland-Busan-Xiamen-Hongkong-Yantian-Tacoma-Vancouver-Tokyo-Nagoya-Kobe-Xiamen-Hongkong-Yantian-Shanghai-LongBeach-Oakland-Tokyo-Nagoya-	42	2	40	13201.1	13.75
12	PSX	Qingdao-Ningbo-Shanghai-Busan-Prince Repert-Seattle-Portland-Kaohsiung-Yantian-Shekou-Shanghai-Busan-LongBeach-Oakland-Busan-Xiamen-Hongkong-Yantian-Tacoma-Vancouver-Tokyo-Nagoya-Kobe-Xiamen-Hongkong-Yantian-Shanghai-LongBeach-Oakland-Tokyo-Nagoya-	42	7	35	12498.6	14.88
13	KPNW	Qingdao-Ningbo-Shanghai-Busan-Prince Repert-Seattle-Portland-Kaohsiung-Yantian-Shekou-Shanghai-Busan-LongBeach-Oakland-Busan-Xiamen-Hongkong-Yantian-Tacoma-Vancouver-Tokyo-Nagoya-Kobe-Xiamen-Hongkong-Yantian-Shanghai-LongBeach-Oakland-Tokyo-Nagoya-	42	9	33	13143.4	16.6
14	PSW 1	Qingdao-Ningbo-Shanghai-Busan-Prince Repert-Seattle-Portland-Kaohsiung-Yantian-Shekou-Shanghai-Busan-LongBeach-Oakland-Busan-Xiamen-Hongkong-Yantian-Tacoma-Vancouver-Tokyo-Nagoya-Kobe-Xiamen-Hongkong-Yantian-Shanghai-LongBeach-Oakland-Tokyo-Nagoya-	42	9	33	13143.4	16.6

Figure 6 - Speed calculation of C shipping company services

Source: C shipping company Website and BLM-shipping

Figure 6 shows part of the speed calculation. All the routes listed are all weekly services, so that it is easy to calculate the average speed of vessels calling at each bunkering port.

Table 9 - Average speed of container vessels calling at eight ports

Port	Fos	Rotterdam	Singapore	LA	Genoa	Panama	Busan	HK
Average Speed	22.22	18.15	18.21	15.63	22.88	16.30	16.87	18.24

Table 9 shows the average speed of vessels calling at each bunkering port. It can be understood that the more bunker will be consumed when the speed is higher. Then the weight of bunker price can be determined as follows:

$$\text{Weight}_{LA} = \text{Average Speed}_{LA} / \text{Sum of Average Speed of Eight Ports}$$

Table 10 - Weight of bunker price at eight ports

Port	Weight
Fos	0.1496
Rotterdam	0.1222
Singapore	0.1226
Los Angeles	0.1052
Genoa	0.1541
Panama	0.1097
Busan	0.1136
Hong Kong	0.1228

Based on the calculation of Table 8 and Table 10, the comprehensive bunker price can be calculated in excel, using the function of SUMPRODUCT. The final results can be shown in Table 11.



Table 11 - Final results of bunker price (US dollar per tonne)

Year	bunker price US dollars per tonne)	Year	bunker price (US dollars per tonne)
2004 1st	170.47	2009 1st	307.96
2004 2nd	184.17	2009 2nd	450.88
2005 1st	227.40	2010 1st	472.07
2005 2nd	287.79	2010 2nd	473.12
2006 1st	327.76	2011 1st	626.86
2006 2nd	302.51	2011 2nd	667.07
2007 1st	317.39	2012 1st	698.93
2007 2nd	425.87	2012 2nd	639.28
2008 1st	530.31		
2008 2nd	484.58		

The bunker price in Table 11 can stand for the fluctuation of bunker price, which may have the effect on the EBITDA of C shipping company.

#### 4.2.4 The EBITDA of C shipping company

The EBITDA of C shipping company from 2004 to 2012 can be shown in Table 12.

Table 12 - EBITDA of C shipping company (million RMB) since 2004

Year	EBITDA	Year	EBITDA
2004 1st	2,314.74	2009 1st	-2,908.93
2004 2nd	4,720.92	2009 2nd	-1,831.94

2005 1st	4,288.40	2010 1st	2,474.80
2005 2nd	4,335.63	2010 2nd	4,454.49
2006 1st	1,105.98	2011 1st	7,68.47
2006 2nd	3,161.65	2011 2nd	-3,282.79
2007 1st	1,187.33	2012 1st	104.62
2007 2nd	4,746.87	2012 2nd	-2,616
2008 1st	2,433.43		
2008 2nd	1,075.18		

Source: P company annual report and interim report 2004-2012

#### 4.3 Application of the models to C shipping company

All the data has been collected, then the software Eviews 6.0 is used to help to analyze to what extent each type of risk may have the impact on the EBITDA of C shipping company on the basis of the VAR model.

##### 4.3.1 Data input

The process of the VAR model has been introduced. Here, the data, including the bunker price, the interest rate, the exchange rate and the EBITDA of C shipping company, will be input into the Eviews software. Figure 7 shows the data input process.

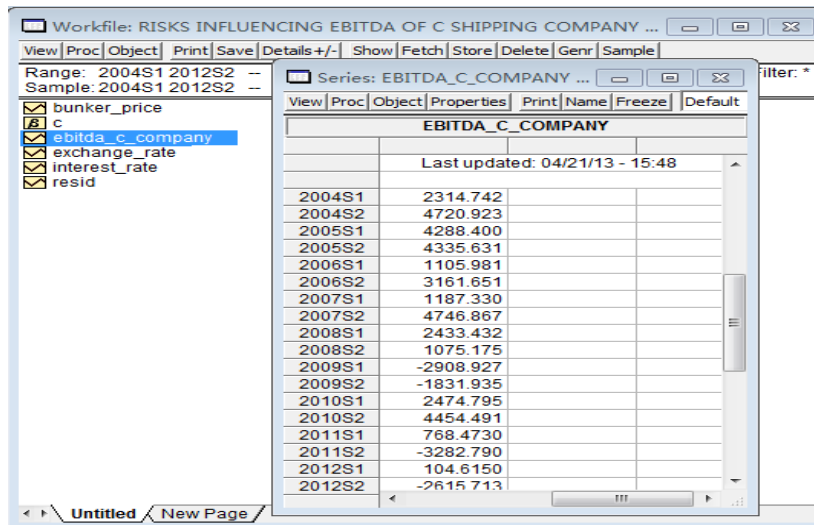


Figure 7 - Input data in Eviews

#### 4.3.2 Granger causality test

The Granger causality test is to test that whether a legged variable of a variable can be introduced to the function of another variable, which means whether the variables have the Granger causality co-relationship. Through the Granger causality test, whether the exchange rate risk, interest rate risk and bunker price risk are the influential factors on the fluctuation of EBITDA of C shipping company. If the Granger causality test is passed, the VAR model can be built.

Pairwise Granger Causality Tests			
Date: 04/21/13 Time: 15:54			
Sample: 2004S1 2012S2			
Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
EBITDA_C_COMPANY does not Granger Cause BUNKER_PRICE	16	0.01480	0.9853
BUNKER_PRICE does not Granger Cause EBITDA_C_COMPANY		5.29009	0.0246
EXCHANGE_RATE does not Granger Cause BUNKER_PRICE	16	2.65723	0.1144
BUNKER_PRICE does not Granger Cause EXCHANGE_RATE		6.11300	0.0164
INTEREST_RATE does not Granger Cause BUNKER_PRICE	16	1.57577	0.2502
BUNKER_PRICE does not Granger Cause INTEREST_RATE		1.64554	0.2370
EXCHANGE_RATE does not Granger Cause EBITDA_C_COMPANY	16	4.56459	0.0360
EBITDA_C_COMPANY does not Granger Cause EXCHANGE_RATE		0.20240	0.8197
INTEREST_RATE does not Granger Cause EBITDA_C_COMPANY	16	1.53712	0.2578
EBITDA_C_COMPANY does not Granger Cause INTEREST_RATE		0.27683	0.7633
INTEREST_RATE does not Granger Cause EXCHANGE_RATE	16	2.70336	0.1109
EXCHANGE_RATE does not Granger Cause INTEREST_RATE		0.10394	0.9022

Figure 8 - Granger Causality test

In Figure 8, it indicates that the probability that the exchange rate is not Granger cause of the fluctuation of EBITDA of C shipping company is only 0.0360. Meanwhile, the probability that the changing bunker price is not Granger cause of volatility of EBITDA of C shipping company is only 0.0246. On the interest rate side, the probability that the changing interest rate is not Granger cause of volatility of EBITDA of C shipping company is comparatively high, at 0.2578. Even so, the interest rate risk is also regarded as the cause of fluctuating EBITDA of C shipping company. In conclusion, through the Granger causality test, whether the exchange rate risk, interest rate risk and bunker price risk are the influential factors on the fluctuation of EBITDA of C shipping company has been tested, and the three so-called types of risks are considered as the influential factors of volatile EBITDA of C shipping company.

### 4.3.3 VAR model

Since the exchange rate risk, interest rate risk and bunker price risk are the influential factors on the fluctuation of EBITDA of C shipping company, the VAR model can be built to make the regression of lagged value the three endogenous variables - the exchange rate risk, interest rate risk and bunker price risk - influencing the other endogenous variable – EBITDA of C shipping company in the model.

The VAR model helps to estimate the dynamic relationship among all the endogenous variables. The VAR formula can be set up. Figure 9 shows the building of VAR formula.

Vector Autoregression Estimates				
	EBITDA_C_...	EXCHANGE_...	INTEREST_...	BUNKER_P...
EBITDA_C_COMPANY(-1)	-0.169097 (0.33962) [-0.49790]	-4.07E-06 (2.7E-05) [-0.15071]	-5.30E-05 (5.3E-05) [-1.00051]	-0.003681 (0.00905) [-0.40666]
EBITDA_C_COMPANY(-2)	-0.369967 (0.27108) [-1.36480]	-4.42E-06 (2.2E-05) [-0.20499]	4.54E-05 (4.2E-05) [1.07258]	0.010203 (0.00723) [1.41209]
EXCHANGE_RATE(-1)	168.6997 (6719.83) [0.02510]	0.336260 (0.53458) [0.62902]	-1.230619 (1.04854) [-1.17365]	-303.7689 (179.122) [-1.69588]
EXCHANGE_RATE(-2)	1795.981 (4533.21) [0.39618]	0.152148 (0.36063) [0.42190]	-0.539744 (0.70734) [-0.76306]	-155.6570 (120.836) [-1.28817]
INTEREST_RATE(-1)	2310.035 (3180.37) [0.72634]	0.274862 (0.25301) [1.08638]	2.489279 (0.49625) [5.01615]	244.7028 (84.7749) [2.88650]
INTEREST_RATE(-2)	-3369.930 (2264.41) [-1.48822]	-0.192259 (0.18014) [-1.06727]	-1.327136 (0.35333) [-3.75009]	-119.7546 (60.3593) [-1.98403]
BUNKER_PRICE(-1)	-10.28688 (17.6826) [-0.58175]	-0.003114 (0.00141) [-2.21394]	-0.008963 (0.00276) [-3.24833]	-0.723776 (0.47134) [-1.53557]
BUNKER_PRICE(-2)	2.199214 (18.4387) [0.11927]	0.000489 (0.00147) [0.33366]	0.000336 (0.00288) [0.11667]	-0.423416 (0.49150) [-0.86148]
C	-4070.470 (38765.1) [-0.10500]	4.574807 (3.08387) [1.48346]	16.82180 (6.04876) [2.78103]	3833.479 (1033.31) [3.70990]

Figure 9 - Vector Autoregressive model

From Figure 9, the VAR formula based on the interest rate risk, exchange rate risk, bunker price risk and EBITDA of C shipping company can be built up. The figures in the parenthesis ‘()’ stand for the standard deviation, while the figures in the square brackets ‘[]’ means the t-statistic.

$$E = 2310.035IR_{-1} - 3369.930IR_{-2} + 168.6997ER_{-1} + 1795.981ER_{-2} - 10.28688BP_{-1} + 2.199214BP_{-2} - 0.1690979E_{-1} - 0.369967E_{-2} - 4070.470$$

E – EBITDA of C shipping company

IR – Interest Rate Risk

ER – Exchange Rate Risk

BP – Bunker Price Risk

#### 4.3.4 Impulse response function

Through the impulse response function, the influential relationship can be analyzed on the basis of time series, which means it shows that how the three types of endogenous variables – interest rate, exchange rate and bunker price - affects the EBITDA of C shipping company respectively.

Figure 10 shows how interest rate, exchange rate and bunker price influences the EBITDA of C shipping company on the basis of time series.

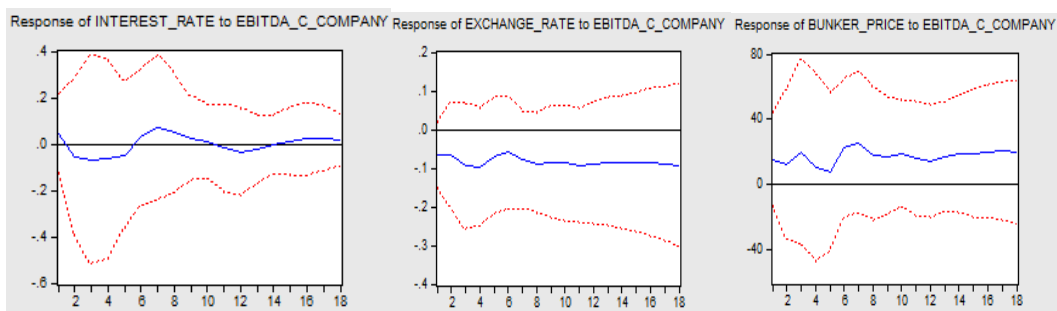


Figure 10 - Impulse Response Function of interest rate, exchange rate and bunker price

As can be seen from Figure 10, interest rate has a significant influence on the EBITDA of C shipping company in the earlier stage. At the meantime, bunker price shows a similar trend as that of interest rate, while it indicates a much more remarkable fluctuation in the bunker price in the earlier stage. On the contract, on the interest rate side, the influential effect of exchange rate risk on the EBITDA of C shipping company is comparatively stable since the earlier stage.

#### 4.3.5 Variance decomposition

Through the variance decomposition, the influential extent of three types of risks on the EBITDA can be analyzed. The variance decomposition provides the information that the importance of three so-called types of risks - interest rate, exchange rate and bunker price - influencing on the EBITDA of C shipping company respectively.

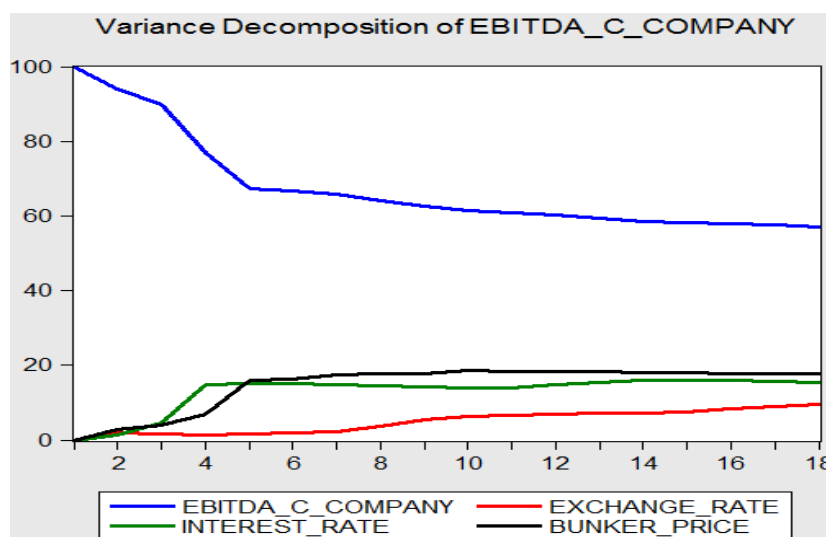


Figure 11 - Variance Decomposition analysis

Figure 11 shows the extents that each type of risks influences the EBITDA of C

shipping company respectively. It is obvious that, the bunker price has the most significant influence on the volatile EBITDA of C shipping company, followed by the interest rate and the bunker price. In the early period, the interest rate has a more effective impact on the EBITDA of C shipping company, then it is exceeded by the bunker price risk.

#### 4.4 Analysis of the data and the solutions

From Figure 11, it is obvious that the fluctuation of bunker price has the most significant influence on the EBITDA of C shipping company, followed by interest rate and the exchange rate. As has been mentioned, it shows an increasing trend in the bunker price from 170.47 US dollar per tonne in the first half of 2004 to 639.28 US dollars per tonne in the second half of 2012. Since the bunker price risk is the main type of risk to C shipping company, the measures should be taken to get rid of the risks.

Here, two ways to avoid the bunker price risk will be introduced. The first one is to slow down the sailing speed. It is said that sailing speed is the most important factor influencing the service bunker consumption, and it consumes fewer bunker when the speed is lower. On the basis of this theory, the total fuel consumption at different sailing speed will be calculated here.

The service Asia/USEC and Gulf of Mexico & Central America Services 4 (AWE 4) of C shipping company will be taken as an example to discuss the way of avoiding bunker price risk. The details of AWE4 will be shown in Table 13.



Table 13 - Details of AWE4

Service	Distance (nm)	Designed speed (knot)	Fuel consumption (tonne per day)	Capacity (teu)
AWE4	24490	24	120	5500

Source: website of C shipping company

The fuel consumption of the AWE4 service at different speed can be calculated according to the following formula.

$$DFC' = DFC_0 * (V' / V_0)^3$$

DFC' – the daily fuel consumption to be calculated

DFC<sub>0</sub> – the initial daily fuel consumption

V' – the reduced sailing speed

V<sub>0</sub> – the designed sailing speed

For example, the daily fuel consumption at 24 knot is 120 tonne, so the daily fuel consumption at 22 knot can be calculated as  $120 * (22/24)^3 = 92.4$  tonne. After the daily fuel consumption is known, it is easy to calculate the total fuel consumption of the AWE4 service of C shipping company. The formulas can be listed.

$$SD = D / (V*24)$$

SD – sailing days of the AWE4 service

D – distance of the AWE4 service

V – sailing speed

$$TFC = SD * DFC$$

TFC – total fuel consumption of the AWE4 service

SD – sailing days of the AWE4 service

DFC – the daily fuel consumption

Table 14 - Total fuel consumption at different speed

Speed (knot)	Sailing days (day)	Daily fuel consumption (tonne)	Total fuel consumption (tonne)
24	42.51	120	5101.50
22	46.38	92.43	4286.68
20	51.02	69.44	3542.71
18	56.68	50.63	2869.59

Table 14 states the total fuel consumption of AWE4 service at different speed. When the sailing speed is slowed down to 18 knot, the total fuel consumption is as half as the total fuel consumption at 24 knot, taking up 56% of that at 24 knot. In conclusion, the decreasing fuel consumption has a remarkable effect on avoiding the bunker price risk. Nonetheless, the reducing sailing speed may have a negative impact on the management of the AWE4 service. For C shipping company, it is essential to ensure the punctuality, the falling sailing speed may well cause the late delivery, so C shipping company may save the time the container vessels spent in the ports, which means the working efficiency at ports is very important. Meanwhile, C shipping company can choose to add the vessel on the loop to ensure the on-time delivery.

The second way to avoid the bunker price risk is to collect the Bunker Adjustment Factor (BAF) when the bunker price is going up. The BAF means the container lines can collect from their clients when the bunker price increases. The BAF can be collected in either US dollar per tonne or US dollar per TEU. Here, the service AWE4 is also taken as an example. For C shipping company, it is necessary to calculate the BAF to avoid the bunker price risk. The methods to calculate the BAF

can be shown.

$$BC = TBC * BP$$

BC – bunker cost

TBC – total bunker consumption

BP – bunker price (US dollar per tonne)

$$BAF = BC / C$$

BAF – bunker adjustment factor (US dollar per teu)

BC – bunker cost

C – capacity

Based on the two formulas, in Table 14, the BAF can be calculated when the bunker price goes up.

Table 15 - Calculation of BAF

Year	Speed (knot)	Total fuel consumption (tonne)	Bunker price (US dollar per tonne)	Total bunker cost (US dollar)	Bunker cost per teu (US dollar per teu)
2011 1st	18	2869.59	626.86	1,798,835.84	327.06
2011 2st	18	2869.59	667.07	1,914,218.64	348.04

As can be seen from Table 15, if the sailing speed is fixed, when the bunker price increasing from 626.86 US dollar per tonne in the 1<sup>st</sup> half of 2011 to 667.07 US dollar per tonne in the 2<sup>nd</sup> half of 2011, the bunker cost per teu also rises from 327.06 US dollar per teu in the 1<sup>st</sup> half to 348.04 US dollar per teu in the 2<sup>nd</sup> half of 2011. During this period, C shipping company can collect BAF, which can be calculated as  $348.04 - 327.06 = 20.98$  US dollar per teu, to cover the increasing bunker price.

Besides, C shipping company can choose to bunker the container vessels at ports, whose bunker price is the lowest. Among eight ports, which has been chosen, the bunker price at Rotterdam is the cheapest, so that C shipping company can bunker the vessels at Rotterdam as much as possible when the vessels are calling at Rotterdam.

In terms of the interest rate, as is mentioned, shipping industry is a capital intensive industry, and it is important for the C shipping company to decide when to purchase a secondhand container vessel and to build a new vessel. To avoid the interest rate risk, the adequate cash flow should be ensured in the C shipping company when the interest rate is very high. In that situation, C shipping company has enough cash to pay for the contract, so that a loan from the bank is avoided. Furthermore, the interest rate is recommended to be fixed to avoid to interest rate risk.

To reduce the exchange rate risk, C shipping company can collect Currency Adjustment Factor (CAF) when the exchange rate of RMB over one US dollar is declining. Here, AWE 4 is also taken as an example, and the freight rate is supposed to be 2000 US dollar per teu. The voyage takes about 63 days, and it is presumed to start at September 2012 and finish at November. The freight is collected.

Table 16 - Calculation of CAF

	Exchange rate of RMB over one US dollar	Freight calculated in RMB per teu
September 2012	6.34	12,680
November 2012	6.29	12,580

As can be seen from Table 16, because of the decline of the exchange rate, C shipping company would lose 100 RMB per teu. To get rid of such kind of risk, C company can collect 100 RMB per teu as CAF to reduce the loss.

## **Chapter 5 Conclusion and suggestions**

### 5.1 Conclusion

Summarizing what have been discussed in this dissertation, which is an attempt to analyze the risks influencing EBITDA of C shipping company by using the VAR model, the following conclusions can be drawn:

Firstly, three types of risks are identified, named as exchange rate risk caused by fluctuation of exchange rate between RMB and US dollars and Euro respectively, Chinese interest rate risk caused by making investment and the bunker price risks led by rising bunker cost in recent years.

Secondly, the VAR model is used to analyze to what extent each type of risk has the influence on EBITDA of C shipping company. The data, such as the exchange rate, the Chinese interest rate and the bunker price, are chosen to be the indicators standing for exchange rate risk, interest rate risk and bunker price risk. The weighted average method is used to calculate the comprehensive exchange rate and bunker price. The result the VAR model shown is that the fluctuation of bunker

price has the most significant influence on the EBITDA of C shipping company, followed by interest rate and the exchange rate.

Thirdly, C shipping company is recommended to collect BAF when the bunker price has a significant rise to get rid of the bunker price risks. Furthermore, C shipping company may slow down the sailing speed to reduce the fuel consumption. The interest rate risk can be avoided by having enough cash to pay for the purchasing contract, and the interest rate is recommended to be fixed to avoid to interest rate risk.

## 5.2 Suggestions

As shipping industry is a risk-taking industry, to get rid of the risks, it is important for C shipping company to be focus on the change of the external environment, and to be aware of the risks they may be faced with.

Followed by the risk awareness and identification, C shipping company shall make quick responses to the risks, and to take effective methods to get rid of the risks, which may help the company reduce the loss to the largest extent.

Last but not the least, the operating department and the financial department of C shipping company shall cooperate and coordinate to get rid of the risks to the largest extent.

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